CLAIMS

What is claimed is:

1. A filter assembly for filtering a fluid, said assembly comprising:

a plurality of wave coils arranged axially to define a filter element having first and second ends and an inner cavity;

a support engaging one of said first and second ends for supporting said wave coils and for diverting the fluid inside or outside said inner cavity of said filter element; and

each of said wave coils including at least one crest and at least one trough with said at least one crest of one wave coil engaging said at least one trough of an adjacent wave coil to define at least one filtration aperture between each crest and each trough of adjacent wave coils for filtering the fluid diverted by said support.

2. A filter assembly as set forth in claim 1 further comprising an adjustment mechanism engaging at least one of said first and second ends for modifying a length L, extending between said first and second ends of said filter element, to reduce and expand said at least one filtration aperture.

3. A filter assembly as set forth in claim 2 wherein said adjustment mechanism is at least partially disposed in said inner cavity of said filter element.

4. A filter assembly as set forth in claim 2 wherein said adjustment mechanism comprises a base plate engaging one of said first and second ends of said filter element.

5. A filter assembly as set forth in claim 4 wherein said support is further defined as said base plate.

6. A filter assembly as set forth in claim 4 wherein said base plate comprises a base collar and a platform extending from said collar.

7. A filter assembly as set forth in claim 6 wherein said base plate further comprises a shoulder portion defined between said base collar and said platform of said base plate for supporting one of said first and second ends of said filter element.

8. A filter assembly as set forth in claim 6 wherein said platform of said base plate is at least partially disposed in said inner cavity of said filter element to keep said base plate in engagement with one of said first and second ends of said filter element.

9. A filter assembly as set forth in claim 4 wherein said adjustment mechanism further comprises a flange member engaging the other of said first and second ends relative to said base plate, said flange member being adjustably engaged relative to said base plate for modifying said length L to reduce and expand said at least one filtration aperture.

10. A filter assembly as set forth in claim 9 wherein said adjustment mechanism further comprises an adjustment shaft extending from said base plate to engage said flange

member such that said flange member is adjustable relative to said base plate for modifying said length L of said filter element.

11. A filter assembly as set forth in claim 10 wherein said adjustment shaft extends from said base plate though said inner cavity of said filter element to engage said flange member.

12. A filter assembly as set forth in claim 10 wherein said adjustment shaft is threaded.

13. A filter assembly as set forth in claim 10 wherein said adjustment shaft is integrally molded with said base plate.

14. A filter assembly as set forth in claim 10 wherein said adjustment mechanism further comprises an adjustable lock disposed on said adjustment shaft for adjusting said flange member relative to said base plate such that said length L of said filter element can be modified to reduce and expand said at least one filtration aperture.

15. A filter assembly as set forth in claim 12 wherein said adjustment mechanism further comprises a threaded adjustment nut disposed on said threaded adjustment shaft for adjusting said flange member relative to said base plate such that said length L of said filter element can be modified to reduce and expand said at least one filtration aperture.

16. A filter assembly as set forth in claim 15 wherein said adjustment mechanism further comprises a set screw extending through said threaded adjustment nut to engage said threaded adjustment shaft such that said threaded adjustment nut is locked for retaining said flange member in an adjusted position relative to said base plate.

17. A filter assembly as set forth in claim 9 wherein said flange member comprises a flange collar and a yoke extending from said collar toward said base plate thereby defining a shoulder portion of said flange member between said flange collar and said yoke, said shoulder potion of said flange member supporting the other of said first and second ends of said filter element relative to said base plate.

18. A filter assembly as set forth in claim 17 wherein said yoke is integrally molded with said flange collar.

19. A filter assembly as set forth in claim 17 wherein said yoke of said flange member is at least partially disposed in said inner cavity of said filter element to keep said flange member in engagement with the other of said first and second ends of said filter element relative to said base plate.

20. A filter assembly as set forth in claim 17 wherein said adjustment mechanism further comprises at least one pilot spring supported on said yoke of said flange member for

biasing said flange member to decrease said length L to reduce said at least one filtration aperture and for biasing said flange member to increase said length L to expand said at least one filtration aperture.

21. A filter assembly as set forth in claim 20 wherein said pilot spring is further defined as a compression spring.

22. A filter assembly as set forth in claim 20 wherein said yoke of said flange member comprises a base segment defining an opening and said pilot spring is supported on said base segment of said yoke about said opening.

23. A filter assembly as set forth in claim 22 wherein said adjustment mechanism further comprises an adjustment shaft extending from said base plate through said opening and said pilot spring to engage said flange member such that said flange member is adjustable relative to said base plate for modifying said length L of said filter element.

24. A filter assembly as set forth in claim 23 wherein said adjustment mechanism further comprises an adjustable lock disposed on said adjustment shaft adjacent said pilot spring and opposite said base segment of said flange member, said adjustable lock causing said spring to bias said flange member for reducing and expanding said at least one filtration aperture.

25. A filter assembly as set forth in claim 1 further comprising at least one retention post extending through said inner cavity and between said first and second ends of said filter element for maintaining the axial arrangement of said wave coils.

26. A filter assembly as set forth in claim 1 wherein said wave coils are further defined as a wave spring.

27. A filter assembly as set forth in claim 1 wherein each of said wave coils comprises a shearing surface for imparting shear forces on the fluid being filtered.

28. A filter assembly as set forth in claim 27 wherein said shearing surfaces of said wave coils comprise a plurality of ridges enhancing the shear forces imparted on the fluid being filtered.

29. A filter assembly as set forth in claim 27 wherein said shearing surfaces of said wave coils comprise a coating for modifying a flow of the fluid being filtered.

30. A filter assembly as set forth in claim 1 wherein said wave coils extend continuously in an endless path through said at least one crest and said at least one trough and between said first and second ends of said filter element.

31. A filter assembly as set forth in claim 30 wherein said wave coils extend continuously in a helix through said endless path between said first and second ends.

32. A filter assembly as set forth in claim 2 further comprising a controller in communication with said adjustment mechanism such that adjustment mechanism automatically modifies said length L of said filter element to reduce and expand said at least one filtration aperture.

33. A filter assembly as set forth in claim 32 further comprising at least one pressure sensor in communication with said controller for activating said adjustment mechanism to automatically reduce and expand said at least one filtration aperture.

34. A filter assembly as set forth in claim 1 in combination with a filter canister comprising an inlet for receiving the fluid to be filtered and an outlet for delivering the fluid that has been filtered, said filter assembly being disposed in said filter canister.

35. A filter assembly as set forth in claim 34 wherein said filter canister comprises a shelf for supporting said filter assembly in said filter canister.

36. A filter assembly as set forth in claim 35 further comprising an adjustment mechanism engaging at least one of said first and second ends for modifying a length L,

extending between said first and second ends of said filter element, to reduce and expand said at least one filtration aperture.

37. A filter assembly as set forth in claim 36 further comprising a controller in communication with said adjustment mechanism such that adjustment mechanism automatically modifies said length L of said filter element to reduce and expand said at least one filtration aperture.

38. A filter assembly as set forth in claim 36 wherein said adjustment mechanism comprises a base plate engaging one of said first and second ends of said filter element.

39. A filter assembly as set forth in claim 38 wherein said support is further defined as said base plate.

40. A filter assembly as set forth in claim 38 wherein said adjustment mechanism further comprises a flange member engaging the other of said first and second ends relative to said base plate, said flange member being adjustably engaged relative to said base plate for modifying said length L to reduce and expand said at least one filtration aperture.

41. A filter assembly as set forth in claim 40 further comprising a gasket disposed about said flange member, said gasket mating with said shelf of said filter canister to seal said outlet of said filter canister from said inlet of said filter canister.

42. A filter assembly as set forth in claim 34 wherein said inlet of said filter canister is oval-shaped for imparting a vortex onto the fluid received into said filter canister for filtering.

43. A filter assembly as set forth in claim 34 further comprising an inlet valve disposed at said inlet of said filter canister for isolating said filter canister from the fluid to be filtered.

44. A filter assembly as set forth in claim 43 further comprising a controller in communication with said inlet valve for automatically isolating said filter canister from the fluid to be filtered.

45. A filter assembly as set forth in claim 44 further comprising a first pressure sensor disposed at said inlet of said filter canister for determining an inlet pressure and a second pressure sensor disposed at said outlet of said filter canister for determining an outlet pressure wherein said first and second pressure sensors are in communication with said controller such that said controller activates said valve to isolate said filter canister from the fluid to be filtered when said outlet pressure is less than said inlet pressure by a predetermined amount.

46. A filter assembly as set forth in claim 45 further comprising an outlet valve disposed at said outlet of said filter canister for allowing said filter canister to selectively receive fluid for back-washing said filter element when said outlet pressure is less than said inlet pressure by said predetermined amount.

47. A filter assembly as set forth in claim 9 wherein said flange member comprises;

a fixed plate engaging the other of said first and second ends relative to said base plate, and

a sliding plate being adjustably engaged relative to said fixed plate and for modifying said length L of said filter element to reduce and expand said at least one filtration aperture.

48. A filter assembly as set forth in claim 47 wherein said adjustment mechanism further comprises a controller in communication with said sliding plate for automatically adjusting said sliding plate relative to said fixed plate.

49. A filter assembly as set forth in claim 1 further comprising at least one baffle disposed within said inner cavity of said filter element for directing the fluid toward said at least one filtration aperture.

50. A filter assembly as set forth in claim 49 wherein said at least one baffle is hollow such that a filtration additive be can delivered to said at least one filtration aperture through said at least one baffle.

51. A filter assembly as set forth in claim 50 wherein said filtration additive delivered to said at least one filtration aperture through said at least one baffle is steam.

52. A filter assembly as set forth in claim 1 further comprising a plurality of said filter assemblies.

53. A filter assembly as set forth in claim 52 wherein said plurality of said filter assemblies is arranged such that said filter assemblies are in parallel.

54. A filter assembly as set forth in claim 52 wherein said plurality of filter assemblies is arranged such that said filter assemblies are in series.

55. A filter assembly as set forth in claim 52 wherein at least one filter assembly of said plurality is disposed concentrically about another filter assembly of said plurality in a nested configuration.

56. A filter assembly as set forth in claim 55 further comprising a plurality of beads disposed within said inner cavity of said filter element for increasing a surface area of the fluid to be filtered.

57. A filter element for filtering a fluid, said filter element comprising:

a plurality of wave coils arranged axially and having first and second ends and an inner cavity; and

said assembly characterized by each of said wave coils including at least one crest and at least one trough with said at least one crest of one wave coil engaging said at least one trough of an adjacent wave coil to define at least one filtration aperture between each crest and each trough of adjacent wave coils for filtering the fluid.

58. A filter element as set forth in claim 57 in combination with an adjustment mechanism engaging at least one of said first and second ends for modifying a length L, extending between said first and second ends of said filter element, to reduce and expand said at least one filtration aperture.

59. A filter element as set forth in claim 57 in combination with a filter canister comprising an inlet for receiving the fluid to be filtered and an outlet for delivering the fluid that has been filtered, said filter element being disposed in said filter canister.

60. A filter element as set forth in claim 57 wherein said wave coils are further defined as a wave spring.

61. A filter element as set forth in claim 57 wherein each of said wave coils comprises a shearing surface for imparting shear forces on the fluid being filtered.

62. A filter element as set forth in claim 61 wherein said shearing surfaces of said wave coils comprise a plurality of ridges enhancing the shear forces imparted on the fluid being filtered.

63. A filter element as set forth in claim 61 wherein said shearing surfaces of said wave coils comprise a coating for modifying a flow of the fluid being filtered.

64. A filter element as set forth in claim 57 wherein said wave coils extend continuously in an endless path through said at least one crest and said at least one trough and between said first and second ends.

65. A filter element as set forth in claim 64 wherein said wave coils extend continuously in a helix through said endless path between said first and second ends.

66. A method of filtering a fluid with a filter assembly that includes a plurality of wave coils arranged axially to define a filter element having first and second ends and an inner cavity, and a support engaging one of the first and second ends for supporting the wave coils, wherein each of the wave coils include at least one crest and at least one trough with the crest of one wave coil engaging the trough of an adjacent wave coil to define at least one filtration aperture between each crest and each trough of adjacent wave coils, said method comprising the steps of:

flowing the fluid toward the support of the filter assembly;

diverting the fluid inside or outside the inner cavity of the filter element; and

filtering the diverted fluid through the at least one filtration aperture defined between each crest and each trough of adjacent wave coils such that a filtrate of the fluid passes through one of the inside or outside of the inner cavity and a retentate of the fluid is retained on the other of the inside or outside of the inner cavity relative to the filtrate.

67. A method as set forth in claim 66 further comprising the step of adjusting the filter assembly to reduce and expand the at least one filtration aperture.

68. A method as set forth in claim 67 further comprising the step of cleaning the filter assembly.

69. A method as set forth in claim 68 wherein the step of cleaning the filter assembly is further defined as automatically backwashing the filter assembly.

70. A method as set forth in claim 69 wherein the step of automatically backwashing the filter assembly comprises the step of isolating the filter assembly from the fluid to be filtered.

71. A method as set forth in claim 70 wherein the step of automatically backwashing the filter assembly further comprises the step of expanding the at least one filtration aperture.

72. A method as set forth in claim 71 wherein the step of expanding the at least one filtration aperture is further defined as expanding the at least one filtration aperture in response to a pressure differential between the first and second ends of the filter element.

73. A method as set forth in claim 71 wherein the step of automatically backwashing the filter assembly further comprises the step of reversing the flow of the diverted fluid through the at least one filtration aperture such that the retentate of the fluid is dislodged from the inside or the outside of the inner cavity.

74. A method as set forth in claim 73 wherein the step of reversing the flow of the diverted fluid through the at least one filtration aperture is further defined as reversing the flow of the diverted fluid after the at least one filtration aperture has been expanded such that the retentate of the fluid is dislodged from the inside or outside of the inner cavity.

75. A method as set forth in claim 71 where the step of automatically backwashing the filter assembly further comprises the step of flowing a second fluid through the at least one filtration aperture such that the retentate of the fluid is dislodged from the inside or the outside of the inner cavity.